

4.9 GHz

**FCC
December 16, 2003**



MOTOROLA

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Agenda

- **Background**
- **Impact of Mask on Interference**
- **Leveraging Commercial Off-the-Shelf (COTS) Technology**
- **Conclusions**

4.9 GHz Chronology

- **2000** **Public Safety initiates campaign for dedicated PS broadband spectrum**
- **Feb 2002** **FCC designates 50 MHz at 4.9 GHz for Public Safety based on mission critical need**
- **May 2003** **FCC adopts 4.9 GHz technical and licensing rules**
 - » Promotes Efficient Reuse and Interference Protection
 - » Incorporates Flexible Channel Plan for Multiple Scenarios
- **July 2003** **NPSTC raises concern about mask, lack of interoperability standards and loose regional planning rules**
- **Oct. 2003** **Comments/Replies filed with FCC**
- **Oct. 2003** **TIA initiates 4.9 GHz standards activity**
- **TBD** **FCC decision on NPSTC Petition**

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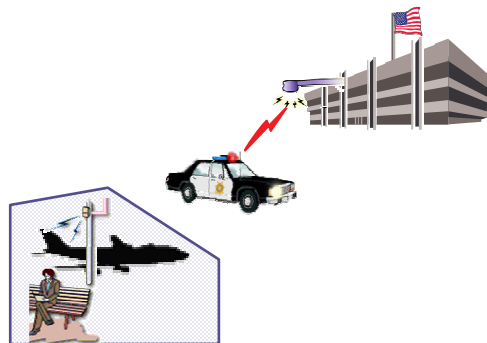
<u>Position</u>	<u>NPSTC</u>	<u>Motorola</u>
• PS needs its own band	Yes	Yes
• Leverage 5 GHz technology for 4.9 GHz	Yes	Yes
• Need a 4.9 industry standard (TIA)	Yes	Yes
• Need regional planning	Yes	Yes
• Leverage DSRC masks	Yes	Yes
• Tighter mask for higher power	Yes	Yes
• Threshold for tighter mask	20 dBm	0 dBm
• User scenario is key deciding factor for interference	Yes	Yes
• 4.9 Scenarios are established	Yes	No
• FCC Mask is significant issue for COTS re-use at 4.9 GHz	Yes	No

Mission Critical Broadband Services for 4.9GHz

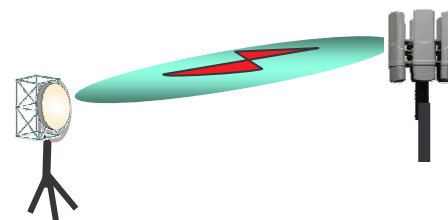
- Several broadband (1.5 - 54Mbps) operational scenarios being targeted
 - Low power PAN (around the person)
 - Medium power WVAN (around the vehicle)
 - Medium to high Power WLAN (around building or incident scene)
 - Fixed and rapidly deployable wireless backhaul links
- Support for mission critical data, video and voice interoperability services with all scenarios



**Wireless Vehicular Area Networks
& Personal Area Networks**



**Wireless Local Area Networks
including Outdoor Hotspots**



**Wireless Backhaul
Fixed & Rapidly Deployable**

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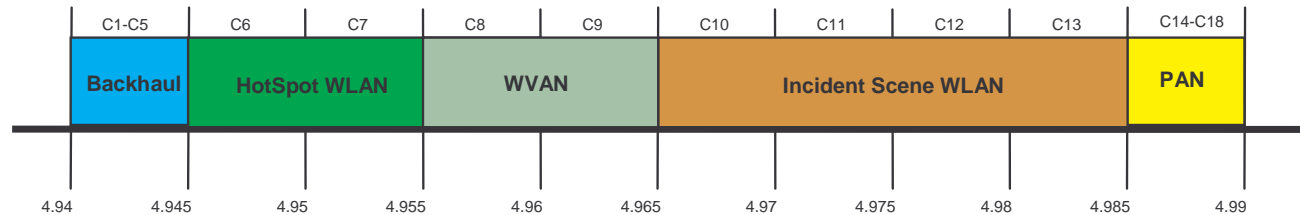
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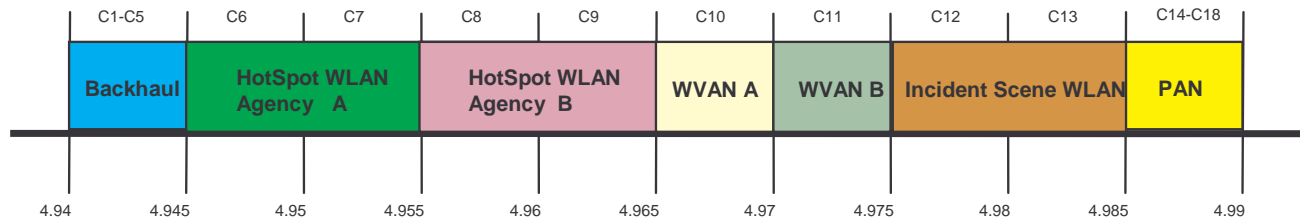
Interference Rules Need to Account for Channel/Use Flexibility

Adjacent channels with multiple channel bandwidths and power levels

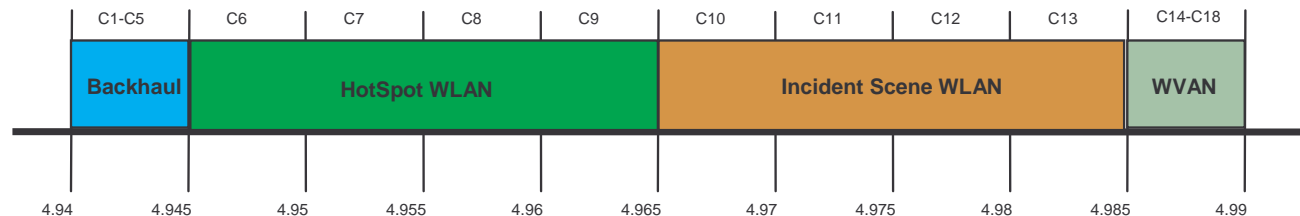
- Multi-service/
Multi-agency
(Fully Shared Networks)



- Multi-service/
Multi-agency
(Partial Sharing)



- Basic Services
(Shared Networks)



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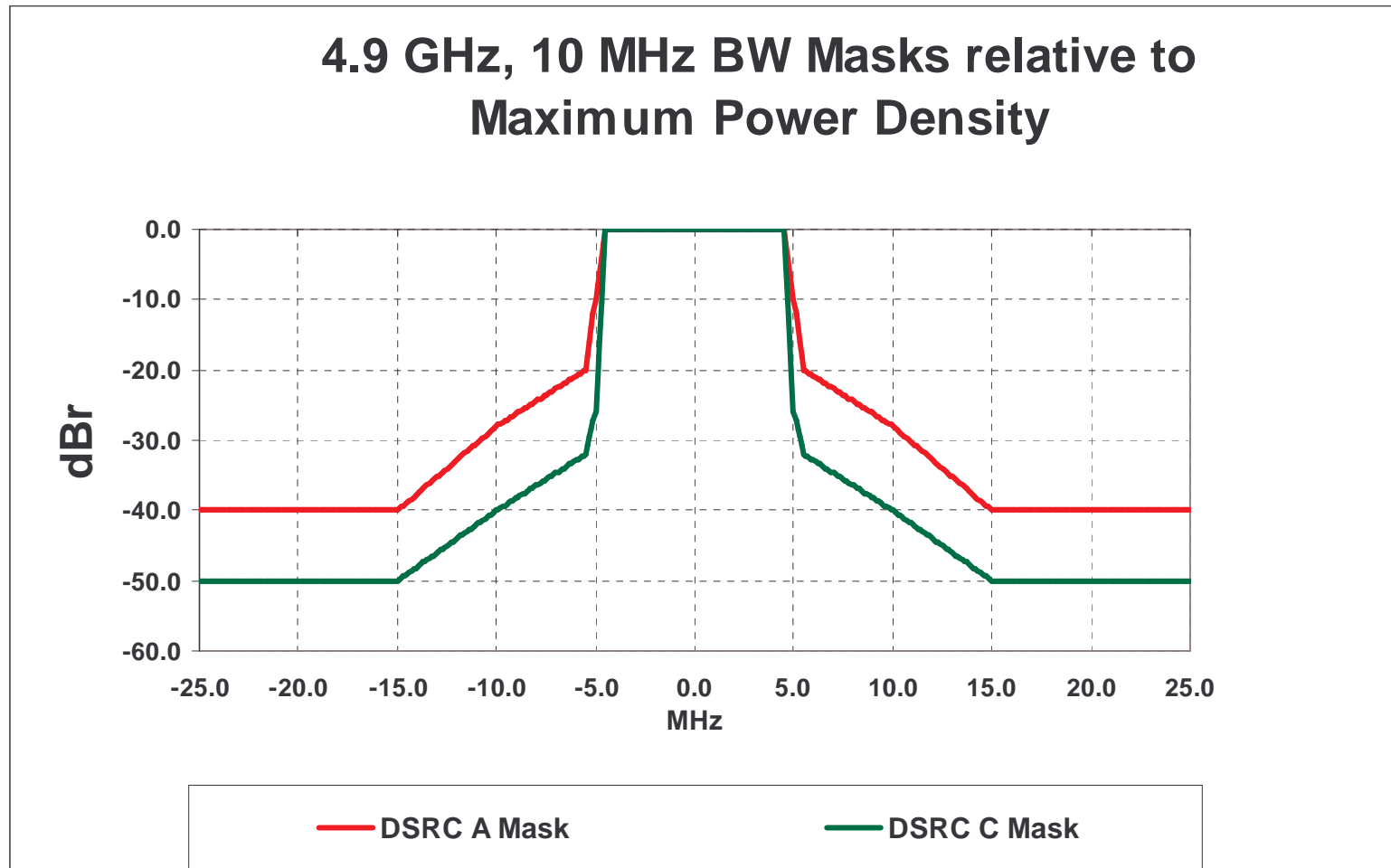
Impact of Mask on Interference

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DSRC Mask A vs Mask C

Difference between center of mask and skirts of DSRC Mask C is at least 10 dB greater than difference of DSRC Mask A (50 dBr vs 40 dBr), which means adjacent channel rejection is also at least 10 dB greater, since shape of skirts is similar.



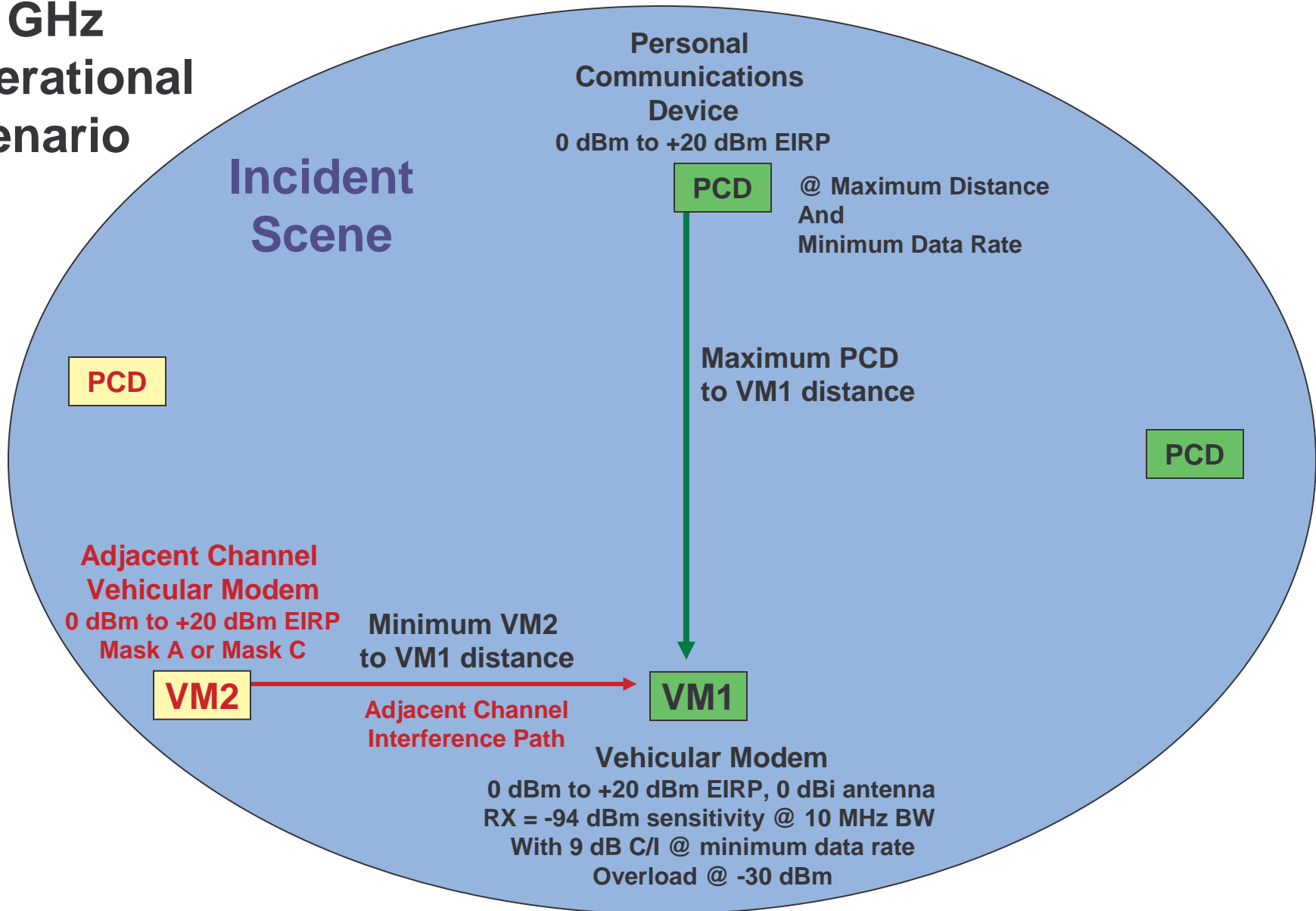
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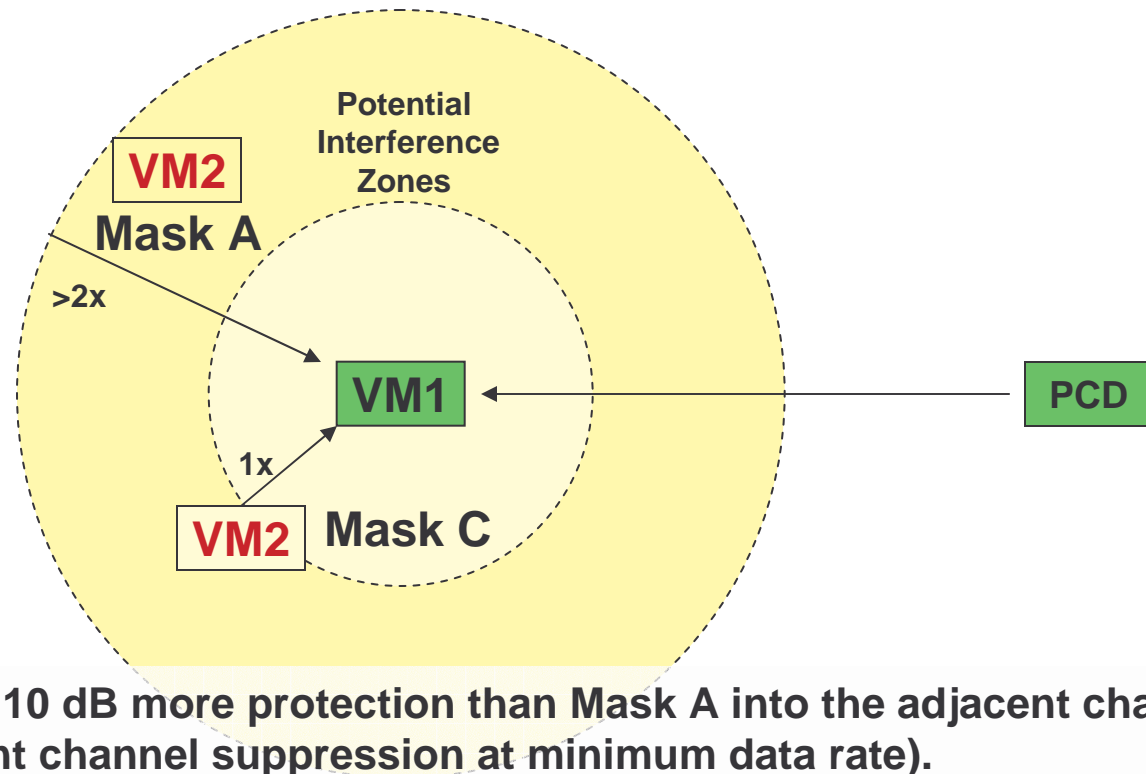
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4.9 GHz Operational Scenario



Near/Far Adjacent Channel Interference when using Mask A versus Mask C:
What is minimum separation distance between VM1 and VM2 ?
What is effect on maximum distance PCD can be from VM1 ?

4.9 GHz Adjacent Channel Interference



Mask C provides about 10 dB more protection than Mask A into the adjacent channel (37 dB vs 27 dB adjacent channel suppression at minimum data rate).

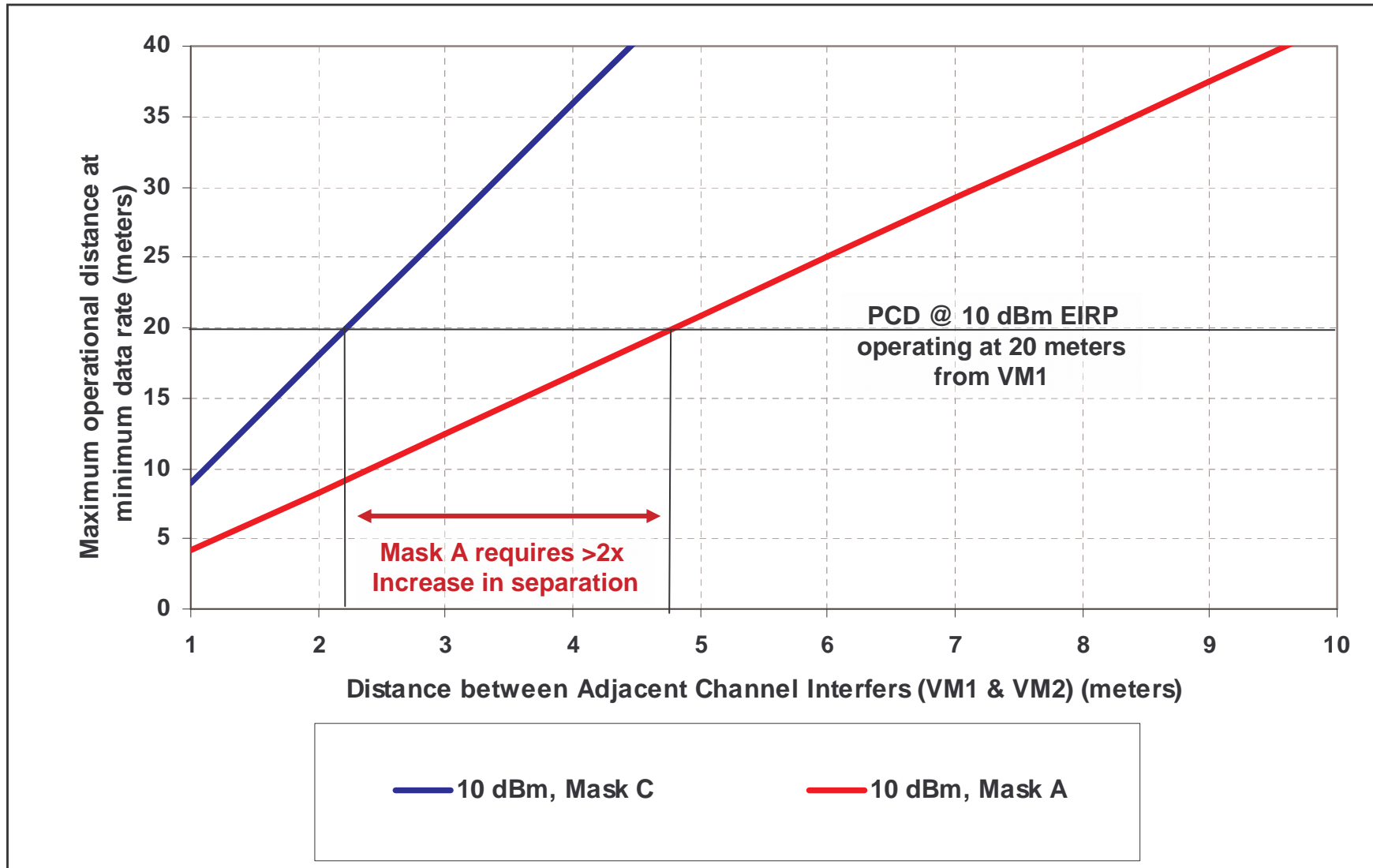
Adjacent channel interference (from VM2) limits the maximum distance between the subscriber device (PCD) and the device it is communicating with (VM1).

For the same operational range of the subscriber device, the radius of interference for Mask A is double that of Mask C, i.e., interference area is 4X.

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Simplified Interference Impact Graphically

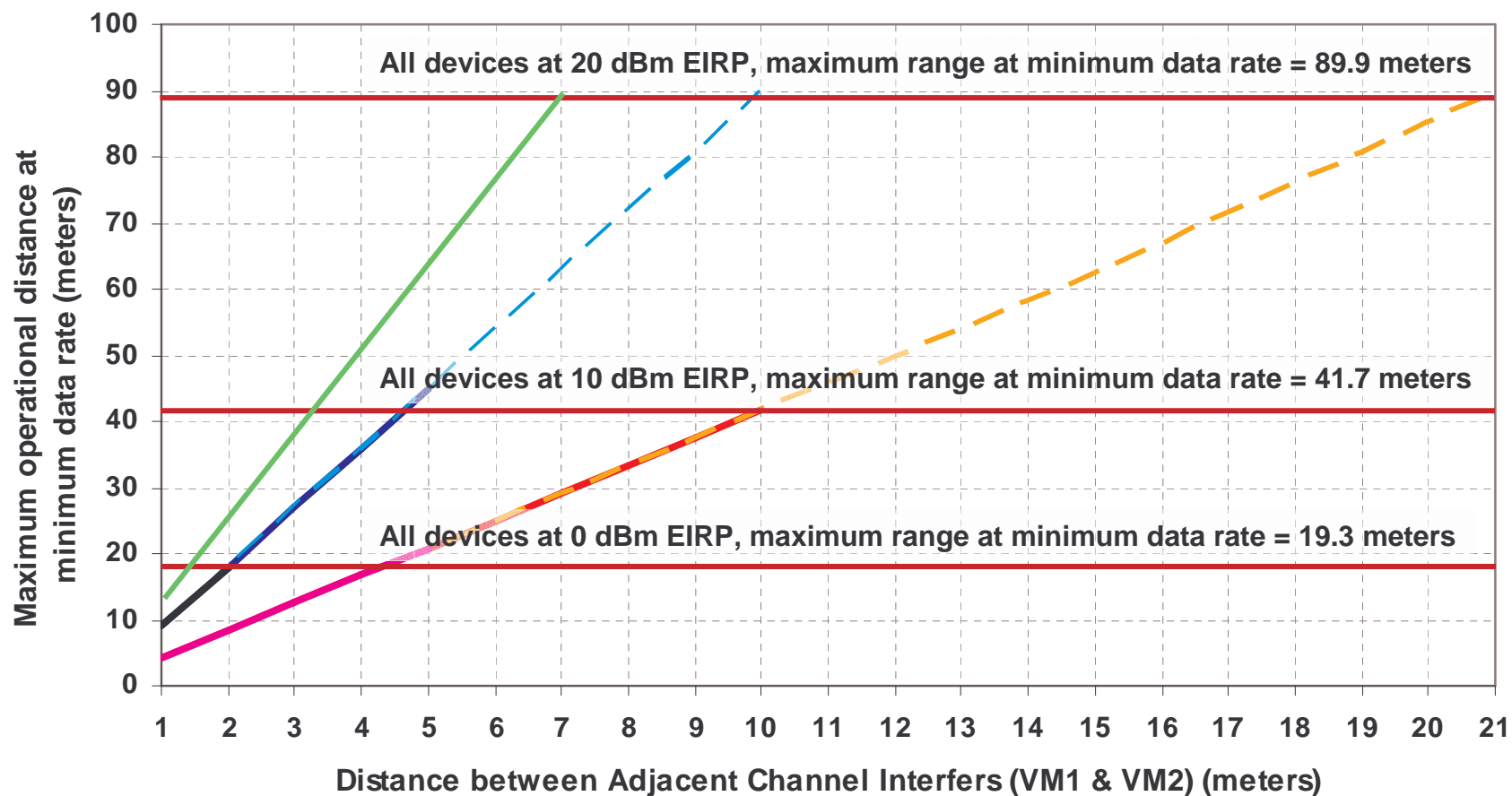


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Estimated Line for FCC mask, adjacent channel suppression = 42 dB.

Interference zone radius = 1.54 m @ 0 dBm, 3.3 m @ 10 dBm, 7.1 m @ 20 dBm

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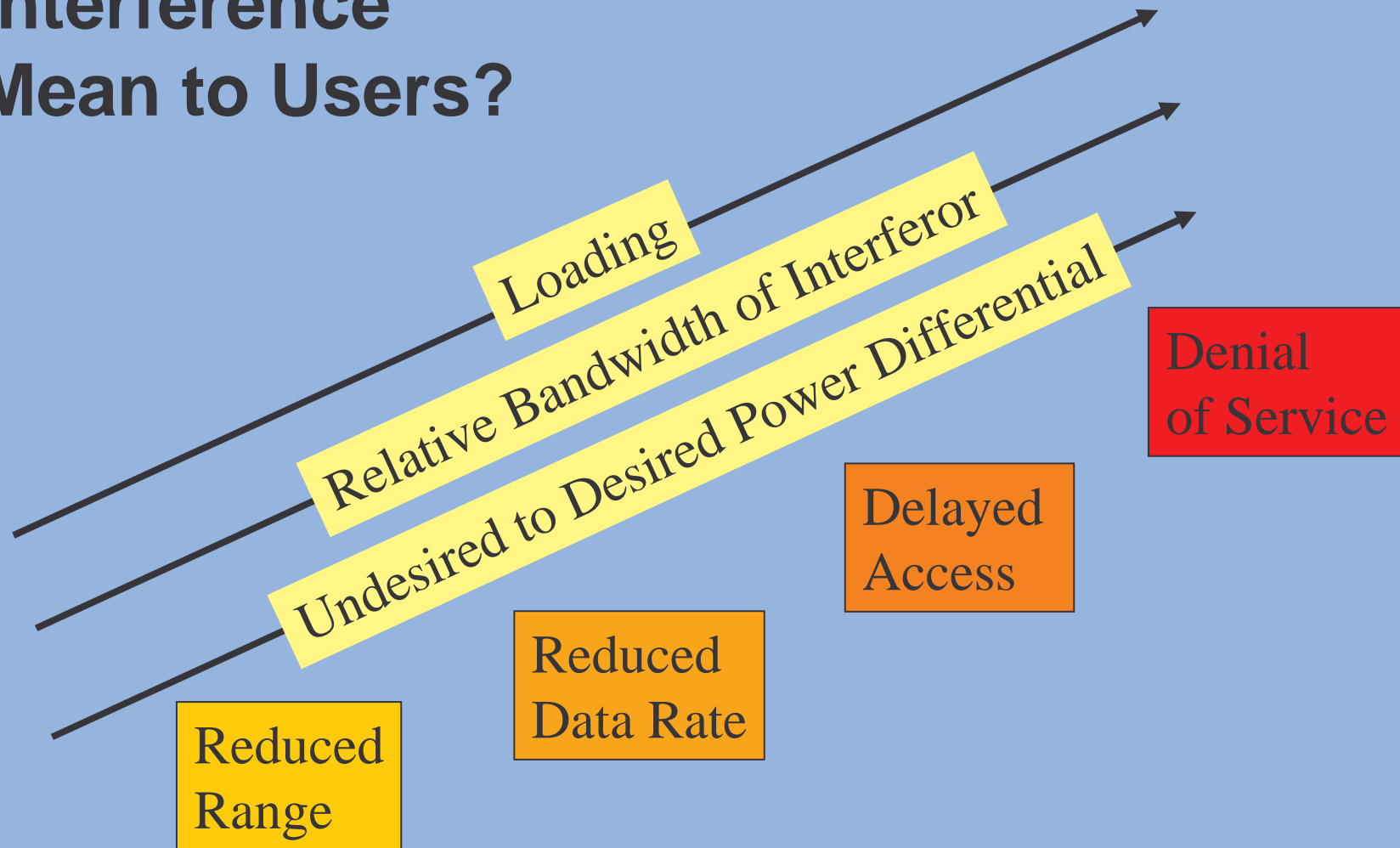
Mask Impact on Interference Zone

EIRP	Operating Range	Interference Radius (meters)		
		FCC 4.9 Mask	DSRC Mask C	DSRC Mask A
0 dBm	19.3	1.5	2.2	4.6
10 dBm	41.7	3.3	4.6	10
20 dBm	89.9	7.1	10.5	21

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What Does Interference Mean to Users?



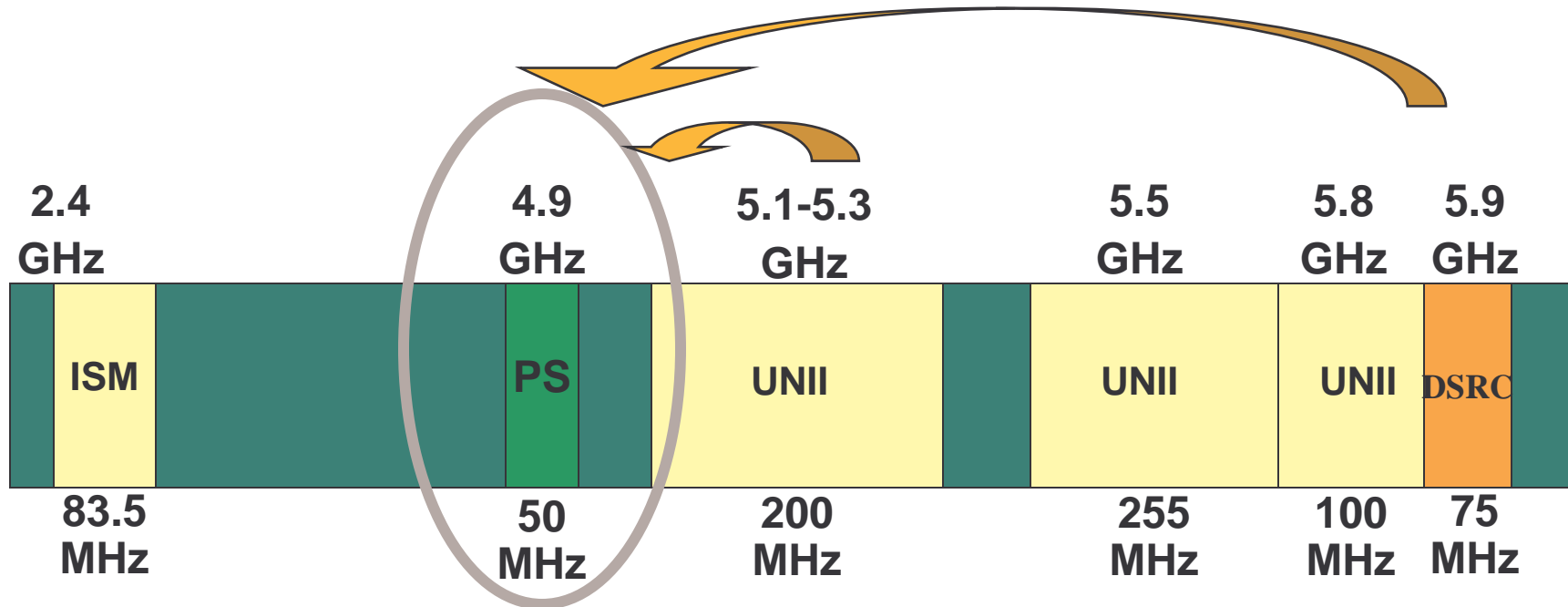
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Motorola Will Leverage COTS Technology for 4.9 GHz



PS - Public Safety Licensed Spectrum

UNII - Unlicensed Broadband Spectrum

DSRC - Digital Short Range Communications Spectrum

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COTS Chipsets Can Be Utilized

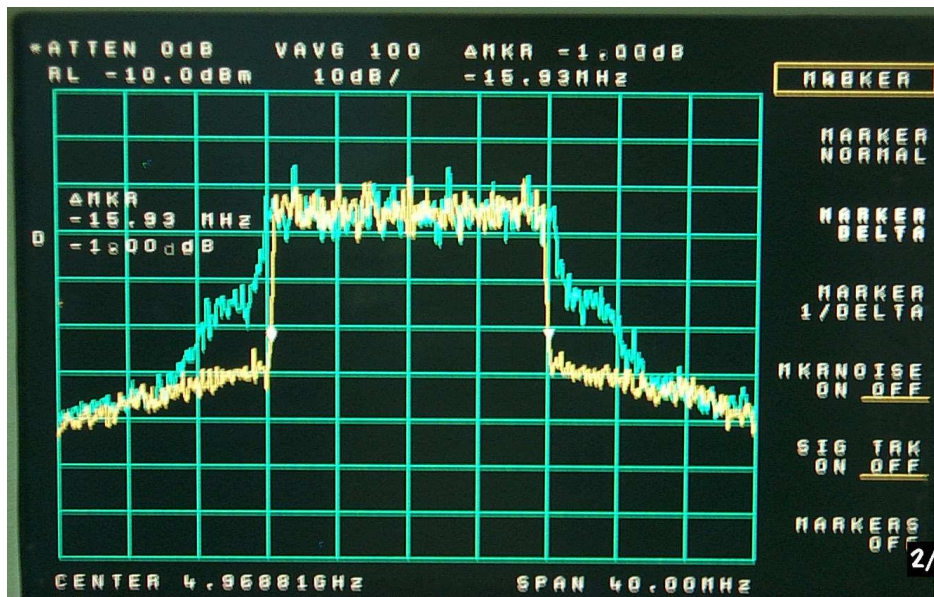
- **Motorola issued RFP to seven COTS 802.11a chipset vendors for compatibility with 4.9GHz rules**
- **Responses indicated that 4 out of 7 vendors could support tightened mask with existing chipsets**
 - **Software only changes in some cases**
 - **Software changes and external filters added in other cases**

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Measured 4.9 GHz signal using COTS based platform meets FCC mask

To validate the feasibility of using COTS chipsets and meet the FCC and DSRC-C spectral mask, Motorola tested COTS chipsets with an additional external filter.



20 MHz BW



10 MHz BW

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Can Japan 4.9 Products Be Used in U.S. Without Modifications ? No

4.9 GHz in Japan*

- Frequency band different than in U.S.
 - 4.9-5.0 GHz & 5.030-5.091 GHz vs. 4.94-4.99 GHz
 - No 10 MHz or 5 MHz channels above 4.95 GHz in Japan
 - Different Channel centers
- 5,10 & 20 MHz bandwidths allowed, but IEEE 802.11j does not include 5 MHz option
- Maximum EIRP levels allowed 19 dB below U.S.
- MW Incumbents in 4.9-5.0 GHz can stay until 2007, delaying volume deployment

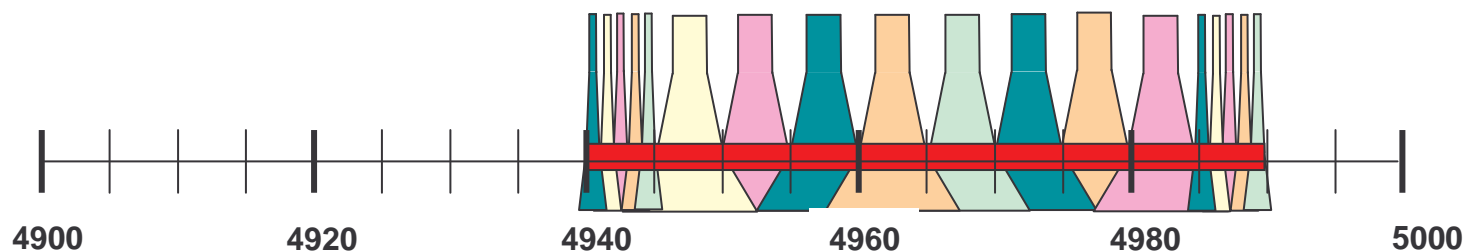
* Article 49-21 of Radio Equipment Ordinance

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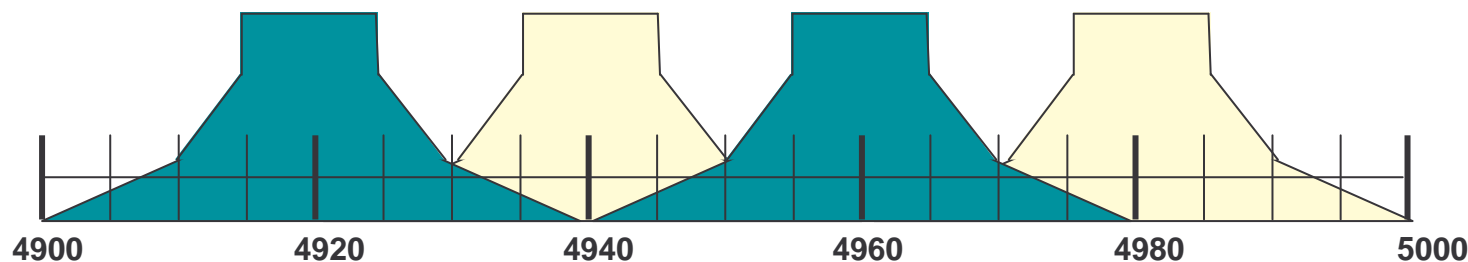
4.9 GHz Band Plan Comparison

United States

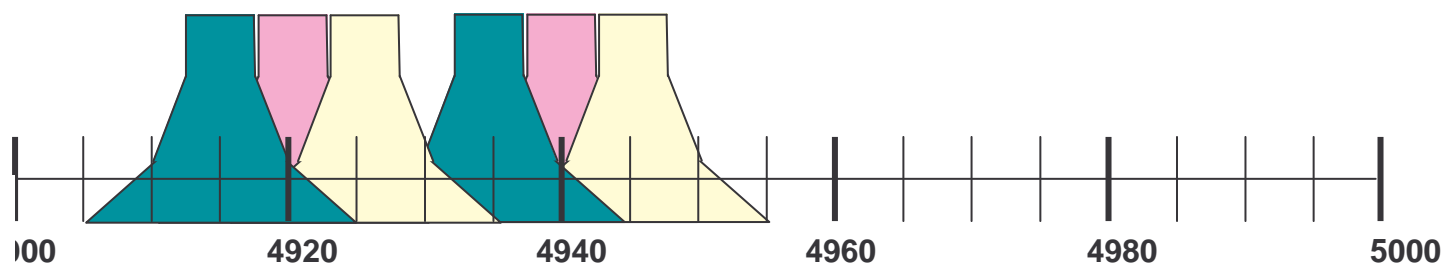


Japan

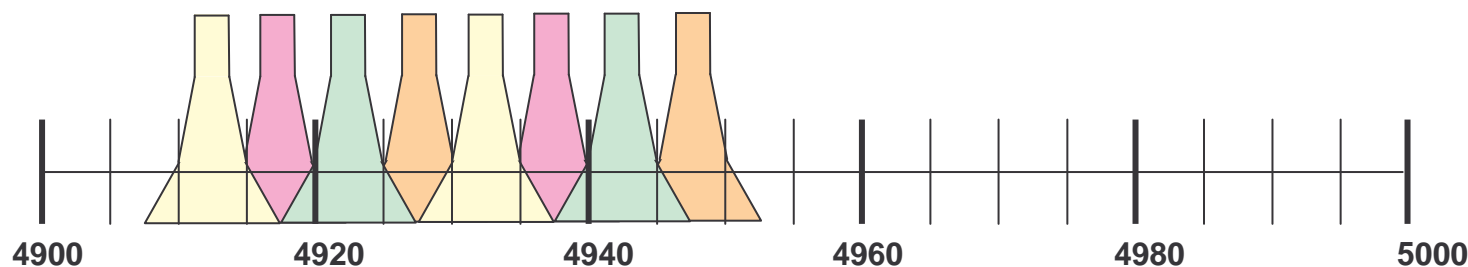
20 MHz Channels



10 MHz Channels



5 MHz Channels



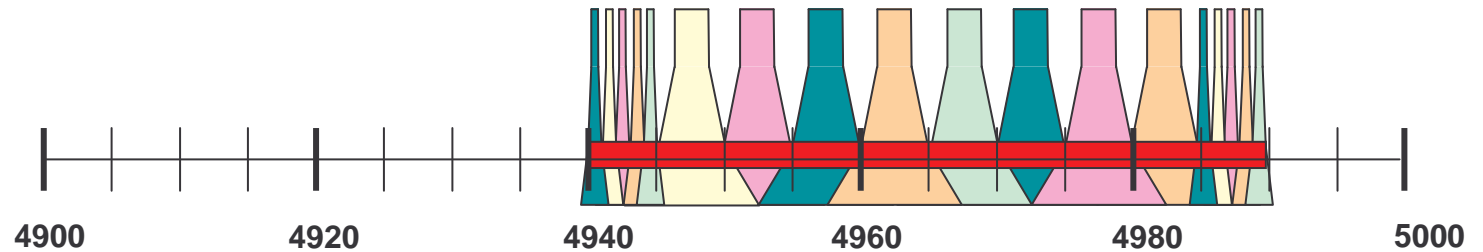
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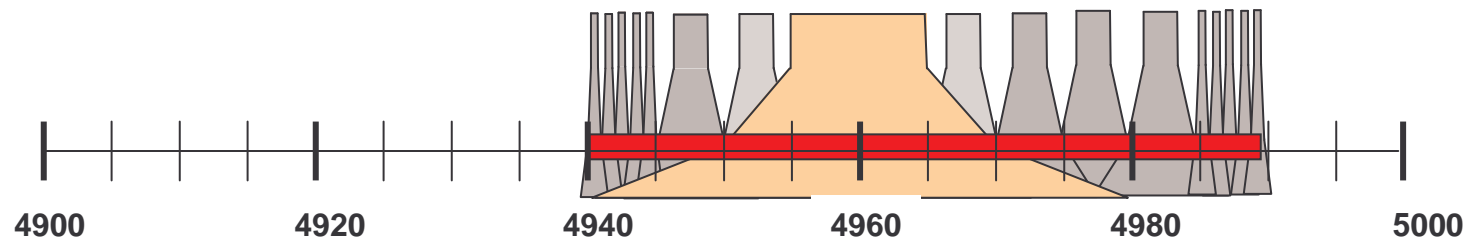
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Limited Band Plan Commonality

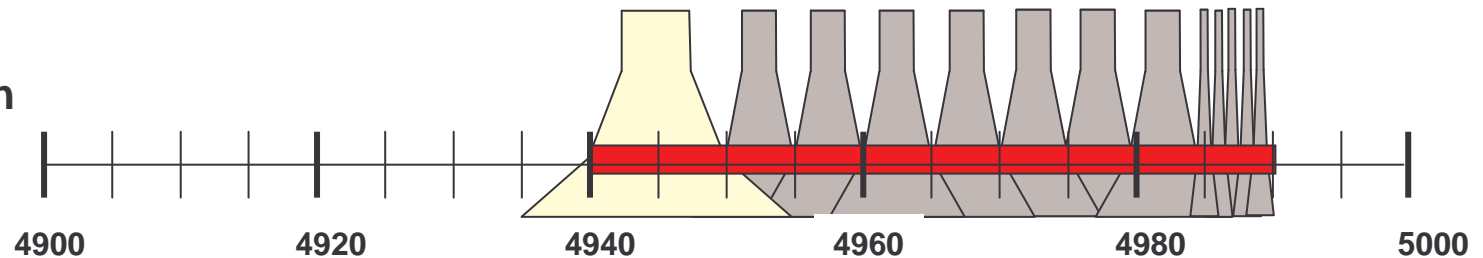
United States Plan



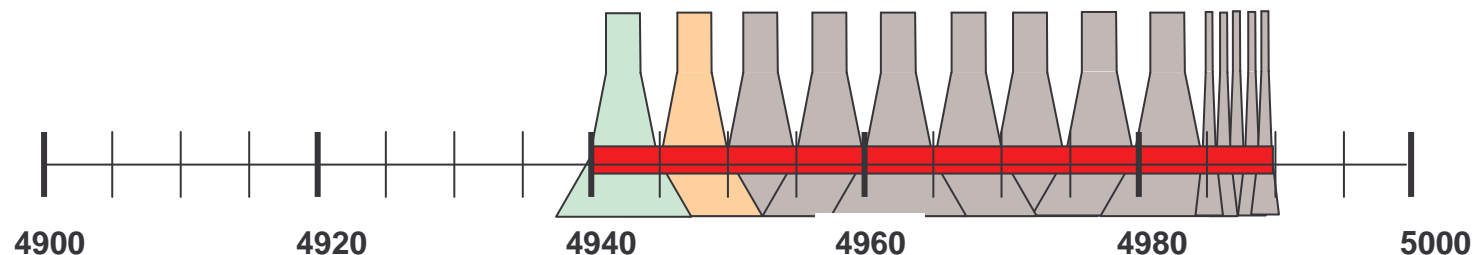
Only one 20 MHz
Japan channel fits
in U.S. plan



Only one 10 MHz
Japan channel fits in
U.S. plan



Only two 5 MHz
Japan channels fit
in U.S. plan



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Conclusions

- **Public Safety users would benefit by minimizing adjacent channel interference at the outset**
 - Greater capacity
 - Higher Quality
 - More Spectrally Efficient
- **Manufacturers can meet FCC mask or DSRC-C mask by adding inexpensive filter external to COTS chipsets and/or by software changes**
- **Manufacturers building Japanese 4.9 band or U.S. UNII products must modify equipment to serve U.S. Public Safety 4.9 market, regardless of FCC mask decision**
- **FCC should be proactive and minimize interference up front before the band is populated**

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